An Action Plan for the Long Term Management of Nuisance Aquatic Vegetation in Cossayuna Lake

A Report prepared for the Town of Argyle
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1. INTRODUCTION

The Town of Argyle is concerned about the long-term management of aquatic vegetation in Cossayuna Lake for its residents and for the local economic well being of the community. The Town supported the aquatic vegetation management program for a number of years before questioning whether there may be other management strategies that could be used in conjunction with harvesting to get a better handle on the abundant growth of Eurasian watermilfoil. Concurring with the recommendation in the *Cossayuna Lake Watershed Management Plan*, the Town commissioned this study to investigate and report on the potential success of other water quality management techniques such as hypolimnetic withdrawal, treatment with alum, artificial circulation and sediment removal. The goal of the entire lake community is to develop an aquatic vegetation management plan that will be affordable and have longer-lasting benefits than annual plant harvesting. The Town of Argyle is also planning to take the lead in terms of applying for various state and federal funding programs. Successful funding is an essential component of any aquatic vegetation management plan selected for Cossayuna Lake.

In most situations where aquatic vegetation is a problem, an integrated approach that utilizes two or more control methods is optimal. By using several practices, both short and long-term benefits can be achieved and aquatic vegetation can be more effectively controlled (Madsen, 2000). Management decisions should also be made on a site-specific basis and tailored to the priorities and goals of the site. The main message to convey is that no management technique is the "best" technique. Individual lakes have individual characteristics and have highly variable needs. Managing lake water quality and aquatic vegetation is very complex and requires a management plan that is flexible enough to turn to other methods when a specific method does not yield the intended results.

Financial limitations of the lake community also need to be taken into consideration when selecting the set of techniques. The most important thing is that the lake association and other involved parties get the continued support of the surrounding communities so that funding for the aquatic vegetation management program is consistent and has a long-term commitment.

2. BACKGROUND

Cossayuna Lake is a shallow, fertile lake roughly 3 miles in length, encompassing approximately 8.64 miles of shoreline. It has a maximum depth of 26 feet and a mean depth of 10 feet. Cossayuna Lake is part of the Upper Hudson River drainage basin with a southward flow draining into Whittaker Creek, Carter Creek and the Battenkill River. The Battenkill flows east into the Hudson River between the towns of Greenwich and Easton.

Cossayuna Lake's 7,467-acre watershed (12 square miles) is distributed among the following townships: Argyle, 85%; Greenwich, 10%, Salem, 4%; Hebron, 1%. A map of the watershed boundary is presented in Figure 1. For the purposes of this study, the important thing to note about the watershed boundary is that it includes Summit Lake and its drainage area. Figure 2, "Hydrologic Map," represents the contours of the bottom of the lake.

Nutrient loading is a critical problem to Cossayuna Lake because excess nutrients such as phosphorus and nitrogen accelerate eutrophication. Eutrophication is the aging process of a lake that leads to increased algae blooms and accelerated plant growth. The increase in growth then contributes to decreased oxygen levels creating a loss of habitat for Cossayuna Lake's exceptional warm-water fishery. Excessive nutrient loading has caused algae blooms, low levels of dissolved oxygen, bottom muck and, occasionally, a foul smell. It contributes large amounts of nitrate and phosphorus in the lake bottom sediments near the shore resulting in abundant weed growth in these areas which significantly impairs activities such as swimming, boating and fishing. It also seriously impacts the aesthetic beauty of the lake.

Figure 3, "Phosphorus Loading", illustrates the major sources of phosphorus loading. The most significant source of nutrient loading in Cossayuna Lake is internal nutrient cycling through the chemical release of phosphorus from the lake bottom during periods of stratification and low oxygen levels in the deepwater zone. The primary sources of nutrient loading from off-lake sources are believed to be from precipitation, directly to the lake surface and in the watershed, plus unfiltered or untreated stormwater. Nutrient loading from failing septic systems and leachfields may be an additional source, but future testing is required to determine its extent. Septic systems may be located too close to the lake, poorly installed or deteriorated with age. Shallow soils with rock outcroppings limit the land area available for subsurface wastewater disposal. Hydraulic failure of individual systems result in a highly reduced percolation rate due to soils which, over the years have been compacted, modified by bacterial layers or have been poorly maintained.

Stormwater runoff is likely the major source of nonpoint source pollution in the watershed. Runoff contains a variety of water quality contaminants including sediment, nutrients, toxic substances and pathogenic organisms. These contaminants adversely impact streams and the lake, particularly near the shoreline. Stormwater management is the most cost-effective way to reduce nutrient and sediment inputs. However, there are recent studies that suggest that limiting phosphorus from external sources in the watershed does not always lead to rapid or long-term improvement in water quality. Although the subject needs further study, research suggests that for lakes that are eutrophic, priorities for management be placed on in-lake control strategies rather than watershed controls (Osgood, 2000). This study recommends that any management focus should not solely concentrate on the control of nutrients from the watershed since the highest value for dollars invested may lie in managing nutrients that are already in the lake.

Best management practices (BMPs) for runoff problems from farms and roads are proven management mechanisms. Many projects use sediment traps, which only focus on the capture of particulates, missing most of the suspended and dissolved nutrients, and have added costs due to maintenance. Wet and dry detention basins and manufactured wetlands are much more effective in capturing nutrients. Detention basins are likely the best method so long as they are sized large enough to capture most of the runoff waters and infiltrate them before they reach the lake. Created wetlands have limited value in this climate because most of the runoff occurs during the winter and spring, when soils are frozen and vegetation is not present. The focus of mitigation should be on reducing present nutrient loads and preventing future nutrients from reaching the Cossayuna Lake.

Shoreline erosion along the lake and streambeds is another significant contribution of nutrients. Factors that influence the degree of sedimentation that can take place from erosion are wave action, exposure from drawdown, lack of vegetation buffer between developed areas and the lake and lack of bank stabilization from rocks, vegetation or sea walls. Stabilizing shorelines with vegetation or structures can reduce this problem. If enforced, setting boat speed limits near the shoreline can reduce the velocity of the waves. Maintenance of near shoreline vegetation such as the rushes and cattails is also an effective way to combat erosion. Keeping lake levels stable during the summer month's serves to limit the amount of shoreline and lake bottom that are exposed to wave action from wind and boats.

Past studies have all made note of the fact that macrophytes have been a problem in the lake for as long as people can remember. By most accounts, Eurasian watermilfoil (*Myriophyllum spicatum*) was introduced in the mid-1970's, took hold almost immediately and quickly became a major management challenge (CLSOLR, 1999).

The excessive growth of Eurasian watermilfoil (hereon referred to as milfoil) is due to several contributing factors. The shallowness of the lake is a primary factor since the light can penetrate to the bottom in much of the lake, both warming the waters and providing the necessary light for the plants to thrive. The high fertility of the lake is due to the slow migration of nutrient-rich soils from the watershed to the lake bottom providing a rich source of nutrients for the plants. The primary management goal at Cossayuna Lake is the need to provide access to open water for boat passage and recreational use. The secondary goal is to increase water clarity and decrease weed growth so as to enjoy swimming in the lake. The strategies outlined in this report recognize these goals.

3. HISTORY OF STUDIES AND ONGOING EFFORTS

The Cossayuna Lake State of the Lake Report and *Watershed Management Plan*, completed in 1999, is the most recent and most comprehensive study of the lake and watershed. The NYS Federation of Lake Associations initiated the Report as part of a pilot program. Technical assistance and funding for the project was provided by DEC. The planning process yielded a series of recommended implementation actions and projects for Cossayuna Lake all of which were designed to improve water quality and the safety and welfare of all lake users. One of the recommendations from the management plan was to investigate various management strategies for the control of aquatic vegetation. This study is a direct result of that recommendation.

Four other significant water quality studies have been conducted over the past 69 years. The first data collected about Cossayuna Lake was reported in *A Biological Survey of the Upper Hudson Watershed* in 1932 by the New York State Conservation Department. The next effort was *launched by the Greater Adirondack Resource and Development Council and resulted in The Cossayuna Lake Technical Report* (1975). The third report, *The Cossayuna Lake Water Quality Study* (1988), was prepared by Skidmore Professor David Smith, Ph.D. in 1988. Cossayuna Lake Improvement Association volunteers through the Citizen's Statewide Lake Assessment Program (CSLAP) conducted a longer-term water quality study. The group participated in the five-year program from 1992-1996 and a summary report was prepared by the DEC's Lakes Services Section. The Darrin Freshwater Institute conducted three new detailed studies over the past several years including *Internal Phosphorus Loading Estimates for Cossayuna Lake*, *Temperature and Dissolved Oxygen Report*, and *Phosphorus Budget Report*. Summaries of each of these reports can be found in the *Cossayuna Lake State of the Lake Report*.

Several efforts have been going on simultaneously since the completion of the *Cossayuna Lake Watershed Management Plan* in 1999. The Management Plan provided an impetus to move forward on several fronts. The Washington County Soil and Water Conservation District has initiated and financially supported several projects that have made a significant contribution to the reduction of pollution in the watershed. The District provided financing and technical assistance for a Barnyard Improvement Project on the only true farm in the watershed. The project was designed to prevent runoff from the barn and yard areas from ever reaching Cossayuna Lake.

The District applied for and received a grant to support a two-year study on a near shore biological and chemical water quality testing program. The study is going into its second season and is being conducted by the Biology Department at Adirondack Community College. The goal of the study is to identify locations where excessive amounts of nutrients are entering the lake. Water quality parameters, including temperature, pH, conductivity, nitrate-nitrogen and ortho-phosphate were measured in streams and other in-lake locations. Additional samples were collected and measured for the presence of fecal coliform and fecal streptococci bacteria (Ahern, 1999).

The District is also participating in a watershed-wide highway culvert inventory and inspection with the Town and County highway superintendents. The goal of the project is to identify culvert locations where cost effective water quality structural improvements could be implemented. This is actually part of an ongoing effort by the District and the local communities to address sedimentation throughout the watershed. A major collaboration came together several years ago when a steep embankment along the west side of Cossayuna Lake was stabilized using labor from municipal sources and technical assistance from the District.

At the recommendation of the 1999 Watershed Plan, the District applied for a grant for the design and construction of a permanent sediment trap through the non-agricultural non-point source portion of the Clean Water/Clean Air Bond Act. The primary goal of the project is to reduce sediment disposition and associated nutrient loading at this location. Should it receive funding, the Town of Greenwich will construct the project approximately 1.25 miles north of the intersection of East Lake Road and Bunker Hill Road.

An Electrofishing Survey was conducted on Cossayuna Lake on June 20 and 21, 2000 by DEC to provide baseline fisheries electrofishing data and to assess the status of the fishery. The findings from this report are as follows:

> "Approximately 25 percent of the largemouth bass collected were legal size. Abundance of largemouth bass less than 6 inches was good and indicative of at least one good young age class. Smallmouth bass abundance was low. Angler harvest of bass seems to be moderate to high but acceptable. Yellow perch were generally small (6 inches), but individuals ups to 10 inches were collected. Pumpkinseeds averaged 7.3 inches but were as large as 8.3 inches. Tiger musky were collected in low abundance, however, this is in line with low stocking rates designed to produce a low density, high-quality fishery. The most abundant fish caught were largemouth bass, yellow perch, bluegill and pumpkinseed."

The Cossayuna Lake Improvement Association has also demonstrated a solid commitment to a long-term watershed management plan by its participation in the Citizen's Statewide Lake Assessment Program and the development of the Cossayuna Lake State of the Lake Report and Watershed Management Plan. The Association has been a full partner with the District in each of the above mentioned projects. In addition, the Association has a demonstrated record in its commitment to educating residents on the issues pertaining to the lake and the various ways they can individually and collectively make a difference.

4. *STATE OF AQUATIC VEGETATION IN COSSAYUNA LAKE*

Aquatic vegetation consists of the microscopic algae referred to as phytoplankton and larger rooted plants called macrophytes. Planktonic algae are the most basic form of aquatic plants and at the beginning of the food chain. They are fed upon by the zooplankton, which comprise the diet of small fishes and larger aquatic invertebrates. Lakes that are low in fertility have limited phytoplankton productivity and, therefore, tend to be very clear. The more fertility, the more phytoplankton, thus the more turbidity in the water and the lack of clarity. Excessive nutrients can cause periodic heavy "blooms" of algae creating a "pea soup" appearance to the water.

Aquatic plants should be recognized for their contributions to the beauty of the lake as well as providing food and shelter for other life in the lake. Emergent and floating plants such as water lilies floating on the lake surface may provide aesthetic appeal, while sedges and cattails help to prevent shoreline erosion plus provide food and cover for birds. Submergent plants like pondweeds and leafy waterweed, provide safe harbor and nurseries for insects, amphibians and fish, and provide food for birds and other animals. Macrophytes can be found throughout the near-shore areas where sufficient light reaches the bottom. Plant growth is primarily regulated by available light, nutrition, space, bottom substrate, and wave action.

Lakefront residents and recreational users have particular concern regarding the exotic or non-native macrophytes that can frequently dominate a native aquatic plant community and crowd out more beneficial species and or the species that are low growing and do not form surface mats. These nuisance species may be introduced by waterfowl, or more likely, boats carrying fragments and seedlings from other infested lakes. Once in the lake, these species are adept at crowding out, dominating and eventually take over native plant communities. Their presence can also act to reduce water flows, which impacts both flood control and the ability of the lake to flush itself out. Ultimately, excessive aquatic vegetation can have a significant negative impact on the viability of the lake, which can dramatically effect property values and tourism.

Non-native species currently found in New York lakes are Eurasian watermilfoil (*Myriophyllum spicatum*), Curlyleaf pondweed (*Potamogeton crispus*), Water chestnut (*Trapa natans*), and Fanwort (*Cabomba caroliniana*).

The submergent aquatic vegetation in Cossayuna Lake is extremely excessive. In virtually all water areas with depths less than 10 feet and with a silt bottom, summer growth extends to the surface almost exclusively. Surveys of aquatic plants in Cossayuna Lake were conducted in 1932 (Meunscher, 1932), 1948 (DEC Fisheries, 1948), 1992 (CSLAP, 1992) and 1998 (DFWI, 1998). Not any of the surveys are particularly comparable since each used a different methodology and the results were not fully reported. The most recent report, "Aquatic Plan Survey of Cossayuna Lake," was commissioned by the Cossayuna Lake Watershed Team and completed by the DFWI in 1998. It is very important for the development of any future management strategies to know the type, amount and location of plant species that are found in the lake.

The report found that the species list for the three surveys was very different. Five aquatic plant species were reported in 1992 while the new survey reported 14 species. Between the three surveys, a total of 15 species were found in the lake. Differences among the surveys are generally in the less common species and emergent species. Emergent species may have been intentionally excluded from past surveys due to their presence at the water's edge rather than submersed and, therefore, not visible. None of the plant species found in Cossayuna Lake is on the New York State Rare Plant List. This fact will greatly simplify future aquatic plant management decisions. Table 1, “Cossayuna Lake Aquatic Plant Surveys,” compares the findings of the three different plant surveys.

Species richness may be linked to bottom slope and sediment type. The site in Cossayuna Lake with the greatest amount of fine-gradient sediment (silts) is associated with the major tributary (inlet). This site supported the most diverse aquatic plant populations. Steep-sloping sites with course sediments were typical of the west shore and generally yielded limited species richness.

According to the DFWI report, the number of species observed (14) indicates average diversity, typical of low-elevation northeastern lakes. In 1988 Lake George reportedly had 47 submersed species while 28 were observed in Lake Luzerne in 1989. The composition of the species list for Cossayuna Lake was similar to that of other nearby lakes. It includes the following species: Coontail, Stonewort, Waterweed, Water stargrass, Duckweed, Eurasian watermilfoil, Water naiad, Yellow water lily, White water lily, Curlyleaf pondweed, Pondweed, Robbin’s pondweed, Flat-stem pondweed, Cattail, and Duck celery.

The survey was conducted on September 9, 1998, and a total of eight transects were examined. Sites were selected that had both shallow and moderately steep slopes and sediment conditions ranged from sand and gravel to soft silt. Coontail was the most commonly found aquatic plant. It is only weakly rooted, frequently growing without any attachment to the lake bottom. This species draws all of its nutritional needs from the water column, thus serving a valuable function in reducing the concentrations of nutrients, therefore competing directly with planktonic algae.

Eurasian watermilfoil was the second most common macrophyte by frequency of occurrence, followed by Curlyleaf pondweed and Waterwort. Frequency of occurrence is based on presence at each transect and depth interval surveyed. Species showed a depth preference, with Eurasian watermilfoil, Coontail and Waterweed dominating in depths of 2 meters or less. Maximum species diversity was found from the water’s edge to a depth of 1 meter. Curlyleaf pondweed and Robbin’s pondweed were more common between 2 and 3 meters depth. Beyond a depth of 3 meters, no aquatic plants were present. This defines the maximum deep of the littoral zone as 3 meters.

Eurasian watermilfoil plants were found throughout the littoral zone. It reached its maximum abundance in waters of 1 to 3 meters deep. At the present time, Eurasian watermilfoil is a major component of the overall plant population of Cossayuna Lake. Eurasian watermilfoil forms a nearly complete ring around the shoreline covering roughly 60 percent of the lake's surface area.

The results of other aquatic vegetation surveys are not as detailed as the 1998 survey. The first survey found in records was conducted by W.C. Muenscher (1932) and only notes from his observations were apparently recorded and later published by DEC (1975). He reported that during the 1932 summer season, the lake became one large weed bed comprised of mostly submersed vegetation. His observations have since been substantiated by residents who were living in the area at that time in their responses to the 1998 Watershed Survey contained in the Cossayuna Lake State of the Lake Report.

The CSLAP aquatic vegetation survey was conducted on July 12, 1992. Volunteers from the CLIA found Coontail, Waterweed, Yellow waterlily and Cattails abundantly present in the shallow waters adjacent to the shoreline. Volunteer's also found Waterweed and Curlyleaf pondweed samples abundant in moderate water depths and mostly green algae in the deepest regions of the lake.

Since 1970, the primary focus of the CLIA has been the development of an annual aquatic vegetation management plan and securing the funding to carry out its initiatives. The plan involves a combination of winter drawdown, harvesting and herbicide applications. The harvesting program costs $10,000-15,000 every year. The Town of Greenwich contributes approximately $2,500-$3,000 and CLIA and its members contribute the remainder. This harvesting is conducted to keep boat lanes open in the main areas of the lake. The other 60 percent were derived from donations of property owners and most of this funding is used to keep individual docks and boat lanes free from vegetation. Table 2, "Aquatic Pesticide Permits," lists the various DEC permits obtained for the application of aquatic pesticide treatments since 1973.

The herbicide program is solely dependent on member donations, which totaled $9,163 in 1997. Volunteers contribute an average of 700 hours per year, equivalent to nearly $8,000, in the operation of harvesting equipment. Table 3, "Aquatic Weed Harvesting Summary," reports the man-hours, harvester loads, truckloads and estimated tons of harvested materials removed from the lake between 1990-1997. Landmarks in the management program include the purchase of a $37,000 Aquamarine H5-200 weed harvester in 1990 and the application of Sonar in 1996.

A one-time application of Sonar™ (Fluridone) SRP (slow release pellet) was applied on Cossayuna Lake several years ago. This application treated a number of small areas. Immediately following the treatment, a significant period of rainfall occurred. Overall, the level of milfoil control was low and not acceptable during the first year. Some observations indicated that the following year milfoil growth was retarded in the treatment area. The lack of effectiveness of Sonar SRP on Cossayuna Lake was attributed to the following conditions:

- Limited treatment zones
- Dilution by rainfall
- Sediments highly enriched with organic materials that may have absorbed some chemicals

5. *ALTERNATIVE MANAGEMENT SOLUTIONS AND COSTS*

a. Alum Treatment

The addition of aluminum salts is a proven lake restoration technique for the control of algae growth. It is traditionally used in lakes that are plagued by nuisance algae blooms. It is not a means of direct control of aquatic plants. It does, however, break the cycle of phosphorus regeneration from the lake deep-water zone. Dramatically increased water clarity is the primary benefit of this method. Alum sulfate (alum) is usually applied in liquid form and, when mixed with lake water, precipitates toward the lake sediments and literally sweeps the water clean of phosphorus. In its new form of aluminum hydroxide, it forms a barrier that retards the release of phosphate from the lake sediments below the barrier layer (Kennedy and Cooke, 1982). Alum treatment is most effective under low oxygen (anoxic) conditions such as those in Cossayuna Lake.

It should be noted that the alkalinity of the lake could be impacted by the alum treatment, particularly in soft water lakes. Large doses of alum can potentially increase the levels of free aluminum and lower the pH to levels that could be dangerous for a number of animal species. The usual technique to mitigate this potential problem is to buffer the acidity by mixing liquid alum with sodium aluminate. Liquid alum works best in lakes where the pH is 6-8. Cossayuna Lake's pH is "basic" with an average of 8.34 (CSLAP) and, therefore, alkalinity is not an issue.

Another issue to consider is that alum only prevents the release of phosphates from sediments below the alum layer. Therefore, if the external nutrient sources are not reduced and the phosphorus input remains high, nutrient rich sediment will only build up on top of the alum layer and begin re-releasing phosphorus into the water column. The faster the rate of sediment disposition, the faster the alum treatment will lose its effectiveness.

Generally, alum treatment is immediately effective and remains effective for a period of 3 to 10 years depending on factors such as the amount of alum that is applied, the rate of sedimentation and external phosphorus loading, and lake bathymetry.

One of the problems with alum treatment is that it does not have a direct nor significant impact on the reduction of rooted macrophytes such as milfoil. In fact, improved water clarity actually has the effect of increasing the amount of available light to rooted macrophytes and could, therefore, increase their density.

Monitoring water quality following alum treatment must be taken into consideration when evaluating this method. At a minimum, pH, alkalinity, dissolved oxygen and temperature must be measured on a daily basis during the application period, which could take up to two weeks (Wedepohl et al, 1990).

Costs relating to alum treatment are very high compared to other methods of algae treatment. The treatment of a 35-acre area over a 5-year period ranges from $4,500 for annual copper sulfate applications to $17,500 for a single alum application ($500 per acre).

b. Artificial Circulation

Artificial circulation is another method used to increase oxygen levels through the water column. Artificial circulation prevents thermal layering by injecting compressed air from a pipe or ceramic diffuser placed in the bottom of the lake. The rising column of bubbles will produce lake-wide mixing at a rate that will eliminate temperature differences between top and bottom waters.

This method could increase the temperature in the hypolimnion as much as 20 degrees Fahrenheit. Another potential drawback is the fact that a re-distribution of oxygen usually often means a diluted effect or that oxygen just becomes distributed over such a large area that it is too low in any one location to support certain fish species. These factors, however, will have less of an impact on the warm-water fishery that is characteristic of Cossayuna Lake.

Artificial circulation has the potential to successfully reduce algae concentrations and reduce the release of nutrients from bottom sediments. While costs run about $150 per acre, it can take 5-10 years to see a difference in reduced densities of rooted macrophytes. A significant drawback to this method is that it requires generators to power the aeration and this will cause additional annual costs and will be extremely noisy to the lake community (NALMS, 1988).

Monitoring is most important during the first two weeks of operations. Both dissolved oxygen and temperature need to be measured throughout the area of impact (Wedepohl, 1990).

c. Hypolimnetic Withdrawal

Hypolimnetic withdrawal involves the removal of nutrient rich, oxygen deficient water at depth, replacing the natural outflow of surface water. The ultimate goal of hypolimnetic withdrawal is to increase the output of phosphorus from the lake. This is accomplished through the removal of hypolimnetic water, which would be replaced with water higher in dissolved oxygen. The residence time of the hypolimnion would be decreased which would in turn decrease the period of anoxia. Ultimately, the depth of the anoxic boundary would change which would lead to a decrease in phosphorus diffusion from the sediments.

This method works by removing water through a siphon or pump and discharging it at the dam outlet at the south end of Cossayuna Lake. This is accomplished by placing plastic piping with holes cut out down the length of the lake from a point (to be determined) to the dam where a pump may be needed to move the water over the dam. Gravity works the system by moving the phosphorus-laden water out of the lake if the outlet is below the bottom of the lake. It is then replaced by water containing higher levels of oxygen. This is a desired result since oxygenated waters have the effect to repress phosphorus from being released from bottom sediments. Figure 4 illustrates this technique.

Hypolimnetic withdrawal is normally a functioning activity during the months of highest productivity and when the lake is normally stratified, June through August. This method can be one of the least expensive options and most effective techniques for a lake community. Eventually, the nutrients in the sediments get "used up" and, assuming that most of the nutrients in the lake are not coming from external sources, the aquatic vegetation will become stressed and eventually die-back (Gibbons and Wagner, 1985).

There are three reasons that this may not be an acceptable method of control for Cossayuna Lake. The first is that even though oxygen levels may rise and the lake may appear clearer, it can take up to 10 years to see any density change in milfoil growth. Meanwhile, other methods such as herbicide treatment and harvesting must continue on an annual basis and employing both techniques could carry prohibitive costs for the lake community. Costs are in the range of $35,000- $130,000 for equipment and installation plus annual operating costs should a pump be necessary. The second consideration is that the effectiveness of this technique, like that of alum, is irrevocably linked to controlling the nutrients that enter the lake from external sources. This is essential before such a method is utilized.

The third potential obstacle is in the release of the siphoned water. Since the water is low in oxygen, high in phosphorus, and contains iron and hydrogen sulfide (potential odor problem), discharging into the downstream receiving waters becomes an important issue. In this case, the receiving waters are Whittaker Brook, Carter Brook and Carter Pond, a 446 acre marsh owned by New York State and managed by the Department of Environmental Conservation as a Wildlife Management Area. One solution is to simply treat these waters before they are released. This can be accomplished by oxygenating the water by mixing using an aeration process to neutralize the hydrogen sulfide or running it through a treatment process to control or filter the iron. Each of these strategies carries additional costs that must be considered by the lake community. A SPEDES permit would also need to be obtained from DEC.

An additional concern regarding hypolimnetic withdrawal is the daily loss of water from the lake. Although further study is needed to determine the potential extent of this problem, lake levels would likely drop substantially unless a system was designed to oxygenate and return the water to Cossayuna Lake.

There are water quality monitoring considerations for this alternative. The following water chemistry parameters should be measured at the discharge site over the first two weeks of operation: Total phosphorus, dissolved reactive phosphorus, ammonium nitrogen, dissolved oxygen, temperature and pH. Dissolved oxygen and temperature should also be measured from surface to bottom at the deepest part of the lake (Wedepohl, 1990). Sampling of the deep lake waters is recommended this summer to determine the quality of the waters that would potentially be discharged during this process.

d. Other Techniques

There are several other aquatic vegetation management techniques that can be considered for Cossayuna Lake that are not exorbitantly expensive and may be reasonably effective. They may be used alone or in conjunction with other methods.

Chemical

Sonar TM AS (liquid) and SRP (pellets), or fluridone is a systemic aquatic herbicide manufactured by SePRO Corporation. This chemical has been used to selectively manage certain common aquatic nuisance plants since 1986. It was licensed for sale in New York State in the mid-1990s. Sonar works by inhibiting carotenoid synthesis in the target plant. This results in photo-degradation of chlorophyll, thereby interrupting photosynthesis and stopping the plant's ability to make food. Damage in susceptible plants usually appears in 7-10 days following treatment. An important factor is that Sonar is equally effective on both Eurasian watermilfoil and Curlyleaf pondweed depending on when it is applied. It is selective because the life cycle of these exotic plants begins much earlier in the spring and ends much later in the fall than most native species. The window for treatment (Sonar SRP) is often in the fall when the highest intake will be by non-native plants. The residue left over in the spring will be available for the intake of milfoil and pondweed, but not by the still-dormant native plant species. This method also gives the native species a chance to take hold in the beginning of the growth cycle and have a greater chance at dominance throughout the growing season.

During the summer 2000, Saratoga Lake was treated with Sonar SRP in two separate 100-acre blocks of surface water area. The first treatment occurred on May 8th followed by a second application on May 26th. During that period of time, a significant rainfall occurred. This created a high flow condition in the lake resulting in a lack of acceptable milfoil control. SePRO issued a guarantee for 70-80 percent control by the use of Sonar SRP in accordance with their approved plan. In order to control the milfoil, four low-dose subsequent treatments with Sonar AS were completed in June and July of the same year. Sonar AS was selected since the milfoil had topped out and was near the surface of the lake forming mats of vegetation. By the end of August, the milfoil had declined significantly at all the treatment sites.

It is believed that the first Sonar SRP applications were not effective due to the effect of dilution, much the same way that Sonar SRP was not effective in Cossayuna Lake several years ago. The use of this form should only take place when the milfoil has grown above the other plants and the liquid version has a probable chance of being less selective.

Sonar selectivity is enhanced by use in early May when milfoil is growing at its most rapid rate. Use of Sonar later in the season will reduce this selectivity advantage. Sonar rate of kill is slow, typically 2-4 weeks for AS and 4-8 weeks for SRP. Therefore, the use of Sonar in June or July will not result in high levels of control until late July or August. It is unknown at this time if Sonar AS application in Saratoga Lake will cause multiple years of control that is typically associated with fluridone application.

Lake Lauderdale also experimented with Sonar SRP in summer 2000 for the treatment of milfoil. Results appear to be mixed, but the outcomes will not be apparent until next season. Since Cossayuna Lake can benefit from the experiences of these two nearby lakes, it is clearly advisable to wait and see what happens next summer prior to considering additional Sonar treatments in Cossayuna Lake. Sonar costs approximately $800 per acre.

Biological

There is some potential for the use of the aquatic weevil (*Euhrychiopsis lecontei*) in Cossayuna Lake as a control for milfoil. There is presently an ongoing demonstration project in Saratoga Lake and there is evidence that the control site experienced a limited level of control (LaMere, 2001). Indications at weevil introduction sites in Lake Bomoseen, Vermont and several lakes in Wisconsin suggest that the weevil may be able to reduce milfoil infestations over a period of time. In many ways, Cossayuna Lake has a better profile in terms of success for building up levels of the weevil that can aid in control. The problem with the introduction of weevils is that the method is not compatible with harvesting unless there is a fair distance between the two activities. Research indicates that harvesting destroys weevil habitat as well as kills the weevils themselves. Weevils cost about $1 each, or $500 per acre.

Sediment Removal

The most dramatic and effective lake restoration technique is the mass removal of aquatic vegetation and the sediments supporting the vegetation. Sediment removal, better known as dredging, can essentially bring the lake back to a condition of 150 years ago. This is before the natural landscape in the watershed was substantially disturbed by human activities causing the lake to slowly fill in with loose nutrient-rich sediments. This process, known as sedimentation, has escalated in the last century because of road building and lakeshore home construction. Considering that the lake has been filling at a rate of about one-quarter inch per year over the last 100 years, there is two feet or more of sediment in the lake that has migrated from the watershed. However, we know from written observations (Muenscher, 1932) the lake was full of "weeds" in the 1930's. This tells us that even at deeper depths the lake can support healthy beds of aquatic vegetation. In order for a dredging operation to be successful three–five feet of vegetation would need to be removed from the lake.

Primary factors for considering sediment removal include:

- <u>Insufficient water depth</u>—water volume is not exceeding the water loss by seepage and evaporation. Maintenance of sufficient water depth to avoid a winter fish kill.
- <u>Nutrient Control</u>: high phosphorus loads causing algae blooms.

- Removing toxic substances: insufficient treatment and disposal practices have caused the need for removal because they may be bio-accumulated by aquatic organisms.
- Rooted-macrophyte removal—Overabundance of rooted aquatic plants interfere with fishing, boating and swimming, reduce oxygen concentrations.

Generally, when a body of water becomes unsuitable for boating, swimming and fishing, sediment removal should be considered to alleviate these problems.

There are several dredging techniques available to address individual lake issues:

- Lake drawdown followed by bulldozer and scraper excavation:
  - Usually only effective in small water bodies.
  - Drawbacks: Water must be removed or pumped from the basin.
Basin must be allowed to de-water in order for heavy equipment to be brought in.
- Grab Bucket Techniques
  - Clamshell bucket dredge—must discharge w/in immediate vicinity, leaves rough, uneven contours to the bottom surface. This method causes great disruption from pulling from the bottom, dragging, and the leakage and overflow of the sediment.
  - Advantages: Transported with ease, good for close to shoreline modifications, works in relatively confined areas.
  -
- Hydraulic Dredges

  Inland lake sediment removal is most commonly accomplished with a cutter head hydraulic pipeline dredge. Primary components of a cutter head dredge include the hull, cutter head, ladder, pump, power unit and pipeline.
  - Suction methods—Operationally, sediment loosened but the cutter moves to the pickup head by suction from the dredge pump, which is usually of the centrifugal type. A pipeline to the remote disposal area then discharges the sediment slurry. A major advantage of the hydraulic cutter suction dredges over bucket types is that they are not confined in operation by the limitation of cable reaches.

One of the direct benefits to dredging the lake bottom is the substantial increase in boat access for recreational activities. In the years following the operation, property values will likely significantly increase due to higher aesthetic values during the summer and better water quality in general. Benefits also extend to the associated costs saved due to the termination of the harvesting program.

Drawbacks to dredging are considerable. The sediment removal process is very expense, would take a long time (two years) and is a very harsh on both the natural and human environment. The removal process requires large diesel trucks, compressions and other pieces of heavy machinery. A site must also me determined where to dispose the unwanted sediment. Disposal sites must be properly designed to avoid environmental destruction. While only an acre or two would be sectioned off at a time, there would be a tremendous disturbance to fish and wildlife. Dredging is not selective in terms of native and non-native plants so some beneficial native plant populations may be lost in the process. Should this method be selected, all methods to manage nutrient inputs from watershed sources must be implemented to ensure that new nutrients are not entering the lake.

Costs relating to dredging are perhaps the most inhibiting factor. A pond approximately one acre in size costs approximately $25,000 for an excavation of four to six feet. Costs are highly dependent on the distance that the spoils must be transported and the length of time the equipment is needed to carry out the operation. Cossayuna Lake requires approximately 300 acres of treatment, and at a cost range of $15,000-25,000 per acre, this would cost $4.5 million to $7.5 million. Naturally, should the operation be scaled back to a minimal area such as only the shoreline zone, the cost would be dramatically less. The drawbacks are that milfoil will begin to intrude into these areas almost immediately and an ambitious effort will have to undertaken to keep these areas milfoil-free.

An additional consideration related to the dredging alternative would be the costs related to permitting and monitoring. Such a project would require a NYSDEC Water Protection Article 15 Permit and a separate Army Corps of Engineers permit. Permitting costs are estimated at $40,000 and monitoring costs are estimated at $15,000. Funding a $5 million project is difficult under the best of terms. It is not, therefore, a realistic alternative for the watershed community to consider.

e. The No Action Alternative

The no action alternative assumes that the lake association continues to manage the milfoil problem with chemical application and mechanical harvesting following the same management plan as they have in past years. This does not appear to be an acceptable alternative since the lake association supported the development of a *State of the Lake Report* and *Watershed Management Plan* several years ago in hopes of generating a greater level of management.

There is an economic component related to the no action alternative. In recent years, the lake community has not been able to keep pace with the expanding need to manage the problem with excessive aquatic vegetation. This is largely due to the impression that the funds being contributed may no longer be benefiting residents to the degree they believe it should. While this may be largely a perceived notion, it cannot be dismissed since the harvesting program depends on community support. In addition, lake residents may not agree to support the program or the lake association if they do not feel the harvesting program is serving them well. This problem can be addressed through continuing outreach and education effort by the lake association.

6. RECOMMENDATIONS

Recommendations made in this report are made with the understanding that the general objective of the lake association, Town of Argyle and DEC is to maintain the lake in a condition in which a variety of lake recreational activities remain viable options for the residents and the public. These generally include swimming, boating and fishing. In order to maintain its high public value as a warm-water fishery, the report also recognizes the importance of maintaining a biological and ecological balance to the greatest degree possible under the circumstances. It also recognizes that there are limited resources available to pay for long-term alternative solutions. Recommendations also assume that the lake is in a mature eutrophic state and, without extreme measures such as dredging, it will continue to decline over time. Recommendations do not focus on the overall eradication of milfoil or restoration of the lake to some earlier stage. They do focus on improving the general water quality of Cossayuna Lake and decreasing the overall biomass of milfoil in the lake.

The actions outlined below arrange a set of strategies based upon the highest cost and best predicted long-term water quality outcome. The most preferred action is listed first followed by a second and third action with associated costs. Mandatory lake-wide strategies represent actions that are low or no cost and should be implemented as soon as feasible in order to give the alternative aquatic plant management strategies to work most effectively. Should one or more of the suggested strategies be successful over time, other strategies can be gradually be folded into the management plan to get an even greater level of control over the aquatic vegetation.

Alternative Action #1

This alternative employs three specific strategies including **hypolimnetic withdrawal, chemical treatment, and mechanical harvesting**. Hypolimnetic withdrawal should be used to address the long-term problem of low dissolved oxygen exists in the lower depths of the lake (*Cossayuna Lake State of the Lake Report*, 1999). This method will also move phosphorus-laden waters out of the lake rendering these nutrients unavailable for algae growth and internal lake recycling. The system should be installed according to engineer specifications and elevations in the lake and at the dam structure. Treatment of the waters before they are discharged into the stream below the dam will be dictated by the SPEDES permit issued by DEC.

The second strategy under this alternative is chemical treatment of the aquatic vegetation from the shoreline out to a distance of approximately 100 feet. Special attention should be paid to the areas around individual docks, beaches and the boat launch. The type of chemical used and the time in which it is applied are dependent upon past successful use. There are several new chemicals on the market that target milfoil but none have been proven as yet to be as effective as 2,4-D (Madsen, 2000)). Individual property owners can get a greater level of control by using rakes or hand pulling around their properties. The lake association should be responsible for imparting information about these techniques to the property owners.

The third strategy under this alternative involves mechanical harvesting in the open areas of the lake. A band of standing milfoil approximately 25 feet wide should be left outside the shoreline chemical application zone to catch plant fragments that float free following cutting. This will help to limit the re-establishment of milfoil after treatment.

In order to get a greatest level of control using the harvester, it is necessary to purchase a new harvester that has a larger cutting tool that can cover more area than the present harvester. An ideal machine would be one with a cutting span of 10 feet. A high-speed transporter barge is also recommended to lessen the amount of trips that need to be made to the off-loading site. Several types of harvesters, barges and combination vessels are available through a number of companies. If a barge is not an option due to expense, the number of off-loading sites could be increased to different geographical locations on the lake so that the harvester would spend less time in transport and more time cutting vegetation.

The operational aspect of harvesting should also be fine-tuned for the future success of the program. Harvesting, if at all possible, should begin in mid-May and continue into mid-September. There is recent evidence that an early cut of the other non-native species, Curlyleaf pondweed, over several seasons can significantly impair its ability to regenerate. The best strategy is to cut the plants as low as possible on the stem right after it reaches the 14th node (McComas, 2000). There is also new evidence that an additional round of cutting of milfoil late into the fall can significantly weaken the plants and suppress their ability to reproduce in the spring.

Monitoring the chemical and harvesting management aspects will rely on the observations made by the harvesting operator and residents. The harvest operator should be given a daily journal in which to report the conditions of the milfoil beds and the area that was cut. Residents should be given survey sheets on which to report the impact of chemical application and any other type of control they are successfully using at their individual properties.

It is also extremely important to monitor the thermal stability of the water column and the discharge waters following the installation of the withdrawal system (Wedepohl, et al, 1990). For the first two weeks of operation, in-lake water samples should be collected from the deepest point in the lake twice a week and tested for dissolved oxygen and temperature. Discharge waters should also be collected twice a week and tested for total phosphorus, dissolved reactive phosphorus, ammonium nitrogen, and pH. Monitoring should continue monthly during the growing season.

COSTS	EQUIPMENT	OPERATING
HYPOLIMNETIC WITHDRAWAL:	$ 45,000	$ 500
CHEMICAL APPLICATION:		$ 10,000
HARVESTER:	$ 50,000	$ 15,000
NEW TRUCK:	$ 35,000	
NEW CONVEYOR	$ 15,000	
BARGE:	$ 20,000	
TOTAL ESTIMATED COST:	**$165,000**	**$ 25,500**

Alternative Action #2

This alternative includes only chemical treatment and harvesting as the main part of its program. As mentioned above, chemical treatment should be applied to the aquatic vegetation from the shoreline out to a distance of approximately 100 feet.

The second strategy under this alternative involves mechanical harvesting in the open areas of the lake. A band of standing milfoil approximately 25 feet wide should be left outside the shoreline chemical application zone to catch plant fragments that float free following cutting. This will limit the re-introduction of milfoil after chemical treatment.

Repeating the recommendation from Alternative Action #1, in order to get a greatest level of control using the harvester, it is necessary to purchase a new harvester that has a larger cutting tool that can cover more area than the present harvester. An ideal machine would be one with a cutting span of at least 10 feet. A high-speed weed transporter barge is recommended to lessen the amount of trips that need to be made to the off-loading site.

COSTS	EQUIPMENT	OPERATING
CHEMICAL APPLICATION:		$ 10,000
HARVESTER:	$ 50,000	$ 15,000
NEW TRUCK:	$ 35,000	
NEW CONVEYOR	$ 15,000	
BARGE:	$ 20,000	
TOTAL ESTIMATED COST:	**$120,000**	**$ 25,000**

Alternative Action #3

This alternative employs an aggressive harvesting program as its sole strategy for the control of both Curlyleaf pondweed and Eurasian watermilfoil and Coontail. Under this scenario, it is necessary to keep the existing harvester for cutting around the shoreline areas. A new harvester with the above specifications should be purchased to cut the areas in the deeper portions of the lake. The present harvesting plan, based upon fees paid by individual property owners, should continue to ensure that paths are open for boat access from docks out into the lake.

The purchase of a barge for the transport is also recommended to enable the harvester to spend as much time cutting as possible. To receive the highest impact from the harvesting program, the harvester should operate for a period of 10 hours per day, 4-5 days a week throughout the strongest part of the growing season. Harvesting, if at all possible, should begin in mid-May (Curlyleaf pondweed) and continue into mid-September. A final cut should be planned for Late November or early December. Other equipment such as a conveyor and truck to transport the harvested materials should also purchased. This strategy should focus on the efficient cutting and removal of aquatic vegetation.

Monitoring should be the same as mentioned above for the operator and residents. It is a reliable way to track what is happening to the milfoil beds from month to month year to year. The results can be used to formulate more effective harvesting patterns in future years.

Simultaneously, an experimental project could be developed for the use of the aquatic weevil (*Euhrychiopsis lecontei*) in Cossayuna Lake as a potential control for milfoil growth. A small site could be isolated off the extreme southeast shore. The area would have to be entirely off limits to mechanical harvesting. The project will take several seasons for researchers to tell if this is a successful management strategy. The first step towards this project is contacting a weevil specialist to check over the lake for the existence of native weevil populations and to get a professional opinion as to how well a weevil demonstration program would fare in Cossayuna Lake.

The present management strategy of drawdown should also be continued with all of the above mentioned alternatives. Winter drawdown is recognized as one of the most effective means to kill exposed aquatic plants. It is also a strategy that works for an extended number of years. The lake association should investigate the potential for altering the dam so that it can accommodate a more extensive drawdown.

COSTS	EQUIPMENT	OPERATING
HARVESTER:	$ 50,000	$ 15,000
NEW TRUCK:	$ 35,000	
NEW CONVEYOR	$ 15,000	
TOTAL ESTIMATED COST:	**$ 100,000**	**$ 15,000**

7. FUNDING OPTIONS

Overview

The completion of the *Cossayuna Lake State of the Lake Report and Watershed Management Plan* provides the framework for opportunities for future access to grant opportunities. Typically, lakes that have developed formal “plans” rank considerably higher than lakes that have not completed plans. Plans indicate that the lake community has gone through the difficult process of developing a clear direction for the future management of the lake through goals and objectives established during public input. Nonetheless, funding options are still limited for water quality projects and, when available, most programs are very competitive.

There are three types of costs that must be financed by the lake community: equipment, labor and monitoring. Financing the costs is limited to private individual contributions, lake associations, special districts, congressional member items, and governmental grants. The majority of costs, however, are usually entirely borne by the lake users and the involved communities whose residents or economy benefits from lake activities. Lakeside property generally has a higher real estate value and assessed values and, therefore, generates more tax revenue than most other areas of the residential community. For this reason, along with the fact that there is usually some sort of public access on the lake, municipalities often participate in financing some of the management options. The other entity that has a stake in the future of the lake is New York State, which owns the boat launch at the north end of Cossayuna Lake. Historically, DEC’s contributions have been primarily limited to technical assistance pertaining to the lake’s fishery and the maintenance of the boat launch.

Grants

Grant funds are not generally available for equipment items such as harvesters and trucks. These costs for these items are typically the responsibility of the landowners around the lake. The need for the purchase of large ticket items such as equipment and whole-lake weed control treatments are often the impetus for the formation of water quality improvement districts. The district is able to distribute costs evenly between all the primary users.

Grant funds are available through local congressional leaders for “member item” Community Assistance Grants. This approach is generally appropriate when it is apparent that the costs for managing the lake well exceed the ability of the primary users to pay. A phased plan that requests an even amount over a three-year period through Community Assistance Grants, the involved local communities and property owners may be the best approach. These requests should be based on a well-constructed aquatic management plan from one of the above alternative recommendations.

Funding for planning and construction projects relating to the prevention of non-point source pollution, which contributes to the proliferation of aquatic vegetation, continues to be available on a competitive basis from the Washington County Soil and Water Conservation District (EQIP grants). Grants are also available through the District through Bond Act funds for non-agricultural projects in the Cossayuna Lake region. Appropriate potential projects were listed and prioritized in the *Cossayuna Lake Watershed Management Plan*. Most all these programs have a local matching component that have to be carefully considered during the application process. There are presently no grant funds available through the NYS Federation of Lake Associations.

Other small construction grants for erosion control projects are available through the Natural Resources Conservation Service and the Conservation District. The NYS Department of Transportation has Enhancement Grants that are related to small projects such as parks, sidewalks, storm drain improvements, landscaping, scenic beautification, trails and other amenities adjacent to locations where roadwork is taking place.

Small educational grants are available through the Cornell Cooperative Extension for the development and distribution of brochures and special programs relating to educating the lake community about lake ecology and pollution management. These typically represent $5,000 or less grants from the EPA's Office of Environmental Education. The program supports environmental education projects that enhance the public's awareness, knowledge and skills to make informed decisions that affect environmental quality.

The EPA also teams with the Cooperative State Research Education and Extension Service to target the identification and resolution of agriculture-related degradation of water quality. The Water Quality Special Research Grants Program has some potential to be accessed to fund the hypolimnetic withdrawal system for Cossayuna Lake. Information about this program follows this report.

The EPA Office of Water has developed a *Catalog of Federal Funding Sources for Watershed Protection* to inform watershed partners of federal monies that might be available to fund a variety of watershed protection projects. This listing also follows the report.

<u>Lake Management District</u>
The option a forming a lake management district is a viable recommendation for the long-term management of aquatic vegetation, recreational activities and overall water quality of Cossayuna Lake. Such a district is a special purpose unit of government that has the power to assess a tax to a specific group of landowners. In 1998, the Cossayuna Lake Improvement Association launched an effort to form such a district with a taxation cap of ninety cents per thousand dollars of property assessment to residents "on or within" the perimeter roads of the lake. The Association received overwhelming support, with70 percent approval (in favor of the formation of a district) with 224 responses returned out of the total 385 sent out.

<u>Recommended Funding Strategy</u>
For the long-term management of Cossayuna Lake, an effort to form a County-Formed Special District should be renewed by the Cossayuna Lake Improvement Association

with the support from the towns of Greenwich and Argyle. The district boundaries should be drawn to reflect only those properties that adjoin Cossayuna Lake.

Actual taxing of the properties should be based upon shoreline footage rather than assessed value. There are approximately 45,600 linear feet of shoreline (8.64 miles) which could conceivably generate $45,000 annually should a tax of one-dollar per foot be assessed. This seems reasonable when measured against the average resident's property frontage of 50-100 feet. Currently residents involved in the chemical and harvesting programs pay approximately $162 per year. An additional $50-$100 per year would raise individual property costs to about $200-$350 annually.

The formation of a district should be developed in conjunction with applying for a Community Assistance Grant through Senator Stafford's office. Lake District or no Lake District, the costs of acquiring the necessary equipment to management the lake to the highest level of efficiency cannot be solely borne by the residents on the lake. It is necessary to request funding for one-time high cost items such as a harvester, barge, truck, and/or conveyor belt.

The two municipalities that collect property taxes on the land around Cossayuna Lake should make a permanent commitment to contribute a negotiated level of funding over a period of years. Funds should be increased from their present level to reflect the higher costs of managing the aquatic vegetation in the lake. Washington County contributed to the program in the early 1990's. The County should also commit to a permanent funding contribution since residents throughout the county utilize the lake for recreation and lake residents contribute county property taxes.

Table 4, "Funding Strategy Summary," found on the following page, outlines the potential sources of funding and amounts of funds that could be generated over the next several years.

Table 4
Funding Strategy Summary

Funding Source	**Present Funding 2001**	**Proposed Level of Funding**			
		2002	**2003**	**2004**	**2005**
Cossayuna Lake Imp. Association [1]	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000
Washington County	-0-	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Town of Argyle	$3,000 + $7,000 study	$10,000	$10,000	$ 10,000	$ 10,000
Town of Greenwich	$ 2,500	$ 3,500	$ 3,500	$ 3,500	$ 3,500
Lake Management District	-0-	-0-	$ 45,000	$ 45,000	$ 45,000
Community Assistance Grant	-0-	$ 30,000	$ 30,000	$ 30,000	$ 30,000
Totals	$ 22,500	$ 58,500	$103,500	$103,500	$103,500

1 Derived from voluntary contributions to the harvesting program from individual property owners.

8. ONGOING WATERSHED STRATEGIES

There are a number of actions that were recommended in the *Cossayuna Lake Watershed Management Plan* that can be implemented now to control the inflow of excessive amounts of nutrients from the watershed into the lake. These include but are not limited to the following:

- Participate in a long-term water quality monitoring program. Monitoring in 2001 should include water quality sampling in June, July and August to determine the treatment specifications should hypolimnetic withdrawal be selected as a means to manage water quality.

- Halt the spread of Eurasian watermilfoil from Cossayuna Lake to other lakes and the spread of other non-native plant species from other lakes to Cossayuna Lake by focusing on prevention. Develop signage describing the problem and rules to be followed before and after launching a boat at the NYS boat launch.

- Develop a stormwater management plan for the entire watershed. This should include identifying specific areas in the watershed that would benefit from stormwater retention basins and locate where sedimentation is presently occurring.

- Construct settling or detention basins where stormwater runoff is a problem.

- Encourage highway departments to implement best management practices (BMP’s) for the construction, repair and maintenance of local roads.

- Develop appropriate guidelines for new construction that would preclude future erosion and stormwater runoff problems. Develop guidelines for homeowners with existing residences as well.

- Conduct an annual roadside survey of potential wetland disturbances, flooding problems, erosion control problems and stormwater “hot spots.”

- Encourage stream corridor management along streams and wetlands in the watershed.

- Develop a stream monitoring program to complement the Association’s lake monitoring program through a partnership with local schools.

- Incorporate monitoring the lake outlet in the water quality monitoring program in order to determine the likely nutrient load to downstream resources.

- Establish guidelines for home fertilizer and toxic chemical use within the watershed. Promote these guidelines through public education programs such as Home Asyst.

- Survey the shoreline for areas of erosion or the potential for future erosion and develop a plan to address these problems.

- Conduct a study of the effects of lake drawdown to see how much shoreline and lake bottom becomes exposed to wind and wave action. Consider whether the positive effects of the annual drawdown are not outweighed by any negative impacts from shoreline exposure.

- All property owners within 100 feet of the lake should be encouraged to bring septic systems up to code. The Association should lobby the county to change the health code to require that individual septic systems be inspected by a qualified person and, if necessary, upgraded when properties change hands, expand significantly, change from seasonal to year round use or experience a change in land use type.

- Establish a septic testing program on a five-year testing cycle supported by county enforcement. Until this is feasible, develop and establish an annual voluntary septic testing program with incentives for landowners such as low cost pump-outs.

- Develop a positive reinforcement program such as distribution of a special decal (perhaps a heron or other symbol of purity) to be displayed by the homeowner in recognition of a septic system which passes a quality test.

- Investigate funding options to defray the cost of supplies and employing a lake manager to perform testing and other functions during the summer months.

- Educate residents on septic system monitoring, maintenance and replacement guidelines.

List of References

Ahern, H. 2000. Cossayuna Lake Water Quality Study. Adirondack Community College, Queensbury, NY.

Eichler, L. 1999. Internal Phosphorus Loading Estimates for Cossayuna Lake. RPI Darren Freshwater Institute. Bolton Landing, NY.

Eichler, L. 1999. Temperature and Dissolved Oxyfgen Report. RPI Darren Freshwater Institute. Bolton Landing, NY.

Eichler, L. 1999. Phosphorus Budget Report. RPI Darren Freshwater Institute. Bolton Landing, NY.

Gibbons, H. and Wagner, S. 1985. Restoration of Lake Ballinger. Lake & Reservoir Management. Volume 11. Lake Geneva, WN.

Greater Adirondack Resource & Development Council, 1975, *The Cossayuna Lake Technical Report*. Warrensburg, NY.

Madsen, J. 2000. Advantages and Disadvantages of Aquatic Plant Management. Lakeline, NALMS. Bloomington, IN.

LaMere, S. 2000. Saratoga Lake Bio-Control Research Project. Crown Point, NY.

McComas, S. 2000. New Tools for Managing the Shallow Lake Environment. Lakeline, NALMS. Bloomington, IN.

NYSDEC. 2000. Electrofishing Survey of Cossayuna Lake. Warrensburg, NY.

NYSDEC & NY Federation of Lake Associations. 1990. *Diet for a Small Lake: A New Yorker's Guide to Lake Management.* Albany, NY.

NYSDEC. 1932. *Survey of the Upper Hudson Watershed*. Albany, NY.

Osgood, D. 2000. Lake Sensitivity to Phosphorus Changes. Lakeline, NALMS. Bloomington, IN.

Smith, D. 1988. *The Cossayuna Lake Water Quality Study*. Skidmore College, Saratoga Springs, NY.

Washington County Soil & Water Conservation District. 1999. *Cossayuna Lake State of the Lake Report*. WCSWCD, Greenwich, NY.

Washington County Soil & Water Conservation District. 1999. *Cossayuna Lake Watershed Management Plan*. WCSWCD, Greenwich, NY.

Wedepohl et al, 1990. Monitoring Lake and Reservoir Restoration. EPA 440/4-90-007.